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<b>(54) Title:</b> HAIR COSMETIC COMPOSITIONS		
<b>(57) Abstract</b>  A liquid hair cosmetic composition comprising: a) from about 0.1% by weight to about 10% by weight (acid basis) of a silicone-containing polycarboxylic acid hair styling copolymer having a vinyl polymer backbone, and having grafted to the backbone a silicone-containing macromer having a weight average molecular weight of from about 1,000 to about 50,000; b) from about 0.01% by weight to about 10% by weight of a non-silicone-containing hair styling resin; and c) the balance comprising a carrier suitable for application to hair. The liquid hair cosmetic products demonstrate excellent hair styling and feel attributes in addition to ease of brush out and improved clarity.		

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## **HAIR COSMETIC COMPOSITIONS**

### **Technical Field**

The present invention relates to hair cosmetic compositions. More particularly, this invention relates to liquid hair cosmetic compositions containing silicone grafted hair styling polymer and non-silicone containing hair styling resin.

### **Background Of The Invention**

The desire to have the hair retain a particular shape is widely held. A common methodology for accomplishing this is applying hair styling, or "setting" compositions to the hair, typically to damp or dry hair. These compositions provide temporary setting benefits, and should be removable by water and/or by shampooing. The materials used in the compositions to provide the setting benefits are generally applied in the form of mousses, gels, lotions or sprays.

High levels of style retention, or hold, are typically expected from hair styling compositions applied as a spray. Style retention is typically achieved by the use of resins, such as AMPHOMER (RTM), supplied by National Starch, and GANTREZ SP 225 (RTM), supplied by GAF. As

used in commercially sold hairspray products, these resins generally have a weight average molecular weight of from about 40,000 to about 150,000. When such resins are incorporated into pump and aerosol hairsprays, they can provide excellent style retention attributes. However, such resins are found to be deficient in the area of hair feel and in particular can give a sticky hair feel.

It is known that certain neutralisable polymers having silicone macromer portions can provide good style retention benefits to the hair while also providing improved hair feel. In other words, such silicone macromer-containing polymers can impart a tactile sense of softness and conditioning to the hair relative to conventional, non-silicone-containing resins without the tacky hair feel traditionally associated with non-silicone hair fixative polymers. Silicone macromer-containing hair styling polymers and formulations containing them are disclosed, for example, in EP-A-0,408,311 issued January 11th 1991, Hayama, et al., US-A-5,061,481, issued October 29th 1991, Suzuki et al., US-A-5,106,609, Bolich et al., issued April 21st 1992, US-A-5,100,658, Bolich et al., issued March 31st 1992, US-A-5,100,657, Ansher-Jackson, et al., issued March 31st 1992 and US-A-5,104,646, Bolich et al., issued April 14th 1992. It is also known that at least partial neutralisation of the silicone macromer containing hair styling polymer is necessary to maximise its utility in hair styling compositions. Typically, silicone grafted copolymers can be neutralised with both inorganic or organic neutralisers or mixtures thereof.

Thus a need exists for hair styling compositions which have a excellent style retention, impart a hair conditioning effect, have a non-sticky hair feel, are easily brushed out and at the same time have stable product and viscosity characteristics and remain fully stable under long term and stressed temperature storage.

It has now been found that addition of low levels of such silicone containing copolymers to liquid hair cosmetic compositions containing traditional hair styling resins imparts excellent hair feel properties while retaining the good style retention associated with the traditional resin. In other words addition of the silicone containing copolymer in relatively

low levels reduces or eliminates the sticky hair feel negatives of the traditional resin without interfering with its bulk hold characteristics.

### Summary of the Invention

According to one aspect of the invention, there is provided a liquid hair cosmetic composition comprising:-

- a) from about 0.1 % by weight to about 10% by weight (acid basis) of a silicone-containing polycarboxylic acid hair styling copolymer having a vinyl polymeric backbone, and having grafted to the backbone a silicone containing macromer having a weight average molecular weight of from about 1,000 to about 50,000 ;
- b) from about 0.01 % by weight to about 10% by weight of a non-silicone-containing hair styling resin; and
- c) the balance comprising a carrier suitable for application to hair.

The compositions for use herein comprise a combination of silicone-containing hair styling copolymer and a non-silicone containing hair styling resin. The total hair styling agent (silicone and non-silicone) is preferably present at levels of from about 0.11 % to about 20%, more preferably from about 0.5% to about 15%, especially from about 1 % to about 10% by weight. In further preferred embodiments of the present invention the weight ratio of the silicone-containing copolymer to non-silicone containing resin is from about 1000:1 to about 1:1000, preferably from about 100:1 to about 1:100, more preferably from about 10:1 to about 1:10 and especially from about 5:1 to about 1:5.

The essential, as well as the optional components of the present invention are described below. All levels and ratios are on a compositional weight basis unless otherwise specified.

### Silicone-Containing Copolymer

The compositions of the present invention contain from about 0.1 % to about 10.0 %, preferably from about 0.5 % to about 8.0 % and especially from about 1 % to about 6 %, of specifically-defined silicone-containing copolymers. It is these polymers which provide the unique hair conditioning and hair setting characteristics of the present invention and which act to modify the feel characteristics of the non-silicone containing resin component. The polymers preferably have a weight average molecular weight of from about 10,000 to about 1,000,000, preferably from about 30,000 to about 300,000, more preferably from about 90,000 to about 300,000 and, preferably, have a Tg of at least about -20°C. As used herein, the abbreviation "Tg" refers to the glass transition temperature of the non-silicone backbone, and the abbreviation "Tm" refers to the crystalline melting point of the non-silicone backbone, if such a transition exists for a given polymer.

The molecular weights and molecular weight distributions of the polymers utilised in the compositions according to the present invention are determined by Size Exclusion Chromatography (SEC). In practice, polymers comprise a distribution of molecular weight species that gives rise to their unique properties. Separation of the molecules is accomplished by Size Exclusion Chromatography (SEC) using a crosslinked polystyrene-divinylbenzene column (MW range =  $100 - 10^7$ ) with a differential refractive index detector and a differential viscometer. A universal calibration curve is prepared from monodispersed polystyrene standards of known molecular weight (MW) and molecular weight distribution (MWD). MW and MWD of the given polymer are determined based on concentration and viscosity responses relative to the calibration.

Preferred polymers comprise a vinyl polymeric backbone, preferably having a Tg above about -20°C and, grafted to the backbone, a silicone containing macromer having a weight average molecular weight of from about 1,000 to about 50,000, preferably from about 5,000 to about 40,000, most preferably from about 10,000 to about 20,000. The polymer is such that when it is formulated into the finished hair care

composition, when dried, the polymer phase separates into a discontinuous phase which includes the silicone containing macromer and a continuous phase which includes the backbone. It is believed that this phase separation property provides a specific orientation of the polymer on hair which results in the desired hair conditioning and setting benefits.

In its broadest aspect, the copolymers utilized in the present application comprise a silicone-containing monomer (hereafter identified as C) together with a hydrophilic carboxylate-containing monomer (B) and optionally a lipophilic monomer (A).

Examples of useful copolymers and how their preparation are described in detail in US-A-4,693,935, Mazurek, issued September 15th 1987, and US-A-4,728,571, Clemens et al., issued March 1st 1988. These copolymers comprise monomers A, B and C as defined above. In preferred embodiments, A comprises at least one free radically polymerizable vinyl monomer or monomers and B comprises at least one reinforcing monomer copolymerizable with A and selected from the group consisting of carboxylate-containing monomers and macromers having a  $T_g$  or a  $T_m$  above about  $-20^{\circ}\text{C}$ . B can be up to about 98%, preferably up to about 80%, more preferably up to about 30%, of the total monomers in the copolymer. Monomer C comprises from about 0.1% to about 50.0% of the total monomers in the copolymer.

Representative examples of A (hydrophobic) monomers are the acrylic or methacrylic acid esters of  $\text{C}_1$ - $\text{C}_{18}$  alcohols, such as methanol, ethanol, methoxy ethanol, 1-propanol, 2-propanol, 1-butanol, 2-methyl-1-propanol, 1-pentanol, 2-pentanol, 3-pentanol, 2-methyl-1-butanol, 1-methyl-1-butanol, 3-methyl-1-butanol, 1-methyl-1-pentanol, 2-methyl-1-pentanol, 3-methyl-1-pentanol, t-butanol (2-methyl-1-propanol), cyclohexanol, neodecanol, 2-ethyl-1-butanol, 3-heptanol, benzyl alcohol, 2-octanol, 6-methyl-1-heptanol, 2-ethyl-1-hexanol, 3,5-dimethyl-1-hexanol, 3,5,5-trimethyl-1-hexanol, 1-decanol, 1-dodecanol, 1-hexadecanol, 1-octadecanol, and the like, the alcohols having from about 1-18 carbon atoms with the average number of carbon atoms being from about 4-12; styrene; polystyrene macromer; vinyl acetate; vinyl chloride; vinylidene chloride;

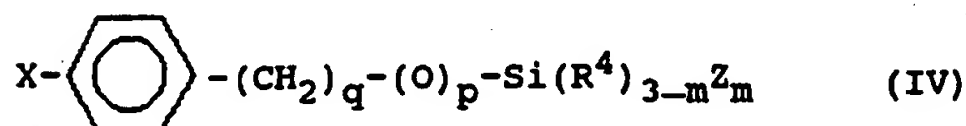
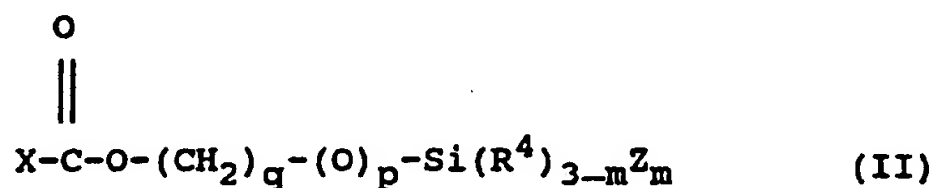
vinyl propionate; alpha-methylstyrene; t-butylstyrene; butadiene; cyclohexadiene; ethylene; propylene; vinyl toluene; and mixtures thereof. Preferred A monomers include n-butyl methacrylate, isobutyl methacrylate, 2-ethylhexyl methacrylate, methyl methacrylate, t-butylacrylate, t-butylmethacrylate, and mixtures thereof.

Representative examples of B (hydrophilic) neutralisable monomers containing a carboxyl moiety include acrylic acid, methacrylic acid, maleic acid, maleic anhydride, half esters of maleic anhydride, crotonic acid, and itaconic acid. Preferred B monomers include acrylic acid and methacrylic acid and mixtures thereof.

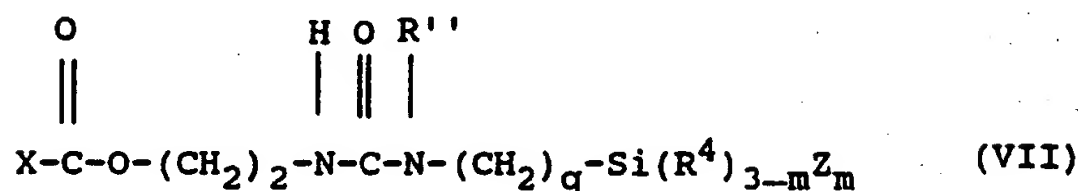
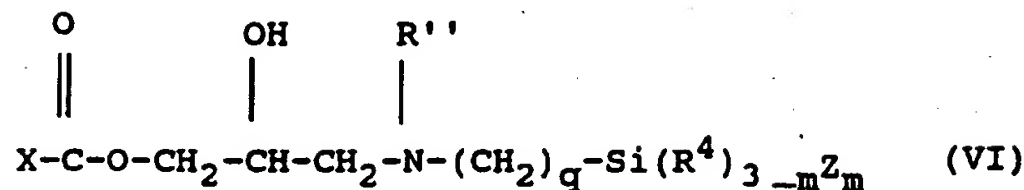
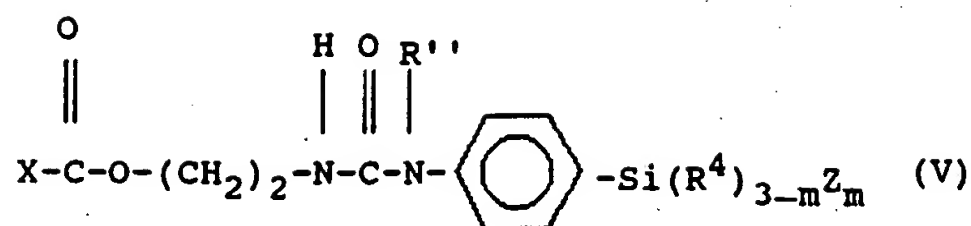
The C monomer preferably has the general formula (I):



wherein X is a vinyl group copolymerizable with the A and B monomers; Y is a divalent linking group; R is hydrogen, C<sub>1</sub>-C<sub>4</sub> alkyl, aryl, alkyl amino, tri(C<sub>1</sub>-C<sub>4</sub> alkyl)siloxy or C<sub>1</sub>-C<sub>4</sub> alkoxy; Z is a monovalent siloxane polymeric moiety; n is 0 or 1; and m is an integer from 1 to 3. C has a number average molecular weight of, at least 500, preferably from 1,000 to 50,000. Preferably, the C monomer is selected from one or more monomers having the general formulae (II to VII):







In these structures, m is 1, 2 or 3 (preferably m = 1); p is 0 or 1; R'' is alkyl or hydrogen; q is an integer from 2 to 6; X is



R<sup>1</sup> is hydrogen or -COOH (preferably R<sup>1</sup> is hydrogen); R<sup>2</sup> is hydrogen, methyl or -CH<sub>2</sub>COOH (preferably R<sup>2</sup> is methyl); Z is



R<sup>4</sup> is alkyl, alkoxy, alkylamino, aryl, or hydroxyl (preferably R<sup>4</sup> is alkyl); and r is an integer from 5 to 700, preferably from 50 to 500, more preferably from 150 to 300. Of the above, formula II is preferred, particularly when p = 0 and q = 3.

The polymers utilized herein generally comprise from 0% to about 98% (preferably from about 5% to about 92%, more preferably from about 50% to about 90%) of monomer A, from about 1% to about 98%

(preferably from about 7.5% to about 80%) of monomer B, and from about 0.1% to about 50% (preferably from about 0.5% to about 40%, most preferably from about 2% to about 25%) of monomer C. The combination of the A and B monomers preferably comprises from about 50.0% to about 99.9% (more preferably about 60% to about 99.5%, most preferably from about 75% to about 98%) of the polymer.

Preferred silicone-containing copolymers for use herein are selected from:

acrylic acid/n-butylmethacrylate/polydimethylsiloxane (PDMS) macromer-20,000 molecular weight (mw) (10/70/20 w/w/w);

acrylic acid/isobutyl methacrylate/PDMS macromer - 20,000 mw (20/60/20 w/w/w) ;

acrylic acid/PDMS macromer - 20,000 mw (80/20 w/w) ;

t-butylacrylate(tBA)/acrylic acid(AA)/PDMS macromer - 10,000 mw (60/20/20) ;

acrylic acid/isobutyl methacrylate/PDMS macromer - 20,000 mw (10/70/20);

acrylic acid/methyl methacrylate/PDMS macromer - 20,000 mw (40/40/20);

acrylic acid/isopropyl methacrylate/PDMS macromer - 20,000 mw (25/65/15);

acrylic acid/methoxyethyl methacrylate/PDMS macromer 20,000 mw (60/25/15);

acrylic acid/PDMS macromer - 20,000 mw (80/20);  
and mixtures thereof.

The silicone-containing copolymers described above can be synthesized by free radical polymerization of silicone- or polysiloxane-containing

monomers with non-silicone- or non-polysiloxane-containing monomers. The general principles of free radical polymerization methods are well understood. See, for example, Odian, "Principles of Polymerization", 2nd edition, John Wiley & Sons, 1981, pp. 179 - 318.

In compositions according to the invention it can be desirable to purify the silicone containing copolymer by removing unreacted silicone-containing monomer and silicone macromer-grafted polymer with viscosities at 25°C of about 10,000,000 centistokes and less. This can be done, for example, by hexane extraction. After drying the resin from its reaction solvent, hexane extraction of the reaction product can be performed by adding an excess of hexane to the reaction product and heating to near the T<sub>g</sub> of the non-silicone portion of the polymer. The mixture is held at this temperature with stirring for about 30 minutes and cooled to room temperature. The hexane is removed by vacuum suction. Two more hexane extraction cycles are preferably conducted in the same manner as above. After the third cycle, residual hexane remaining with the product is removed by distillation and vacuum drying.

Low molecular weight polysiloxane-containing monomer and polymer is solubilized by supercritical carbon dioxide and transported away from the remaining polymer via a transfer line, which is maintained at identical temperature and pressure as the extraction vessel. The extracted materials are collected in an extraction vessel. Following extraction, the system is depressurised and dry, extracted polymer is recovered from the extraction vessel.

#### Non-Silicone-Containing Hair Styling Resin

In addition to the silicone-containing hair styling copolymer the compositions according to the invention comprise, as a second essential component, a non-silicone-containing hair styling resin. This non-silicone containing hair styling resin is preferably colloidally dispersed or solubilized in the hair cosmetic carrier along with the silicone-containing hair styling copolymer. Keeping the two hair styling agents dispersed and solubilised in the hair spray solvent is believed to be important for providing the unique hair setting benefits in combination with excellent

hair feel characteristics which are delivered by compositions according to the present invention.

The non-silicone-containing hair styling resin component of the liquid hair cosmetic compositions of the present invention comprises an anionic, amphoteric, nonionic or cationic polymeric material or mixture thereof. Preferred hair setting resins for use in liquid hair cosmetic compositions according to the present invention are anionic or amphoteric.

The non-silicone-containing hair setting resin is preferably present in an amount of from about 0.5% to about 10%, more preferably from about 1% to about 5% by weight of composition. Hair setting resins suitable for use herein include any resin which is soluble or colloiddally dispersible in the hair cosmetic carrier which in preferred embodiments is an alcoholic solvent which can optionally contain up to about 15%, preferably up to about 10%, more preferably up to about 7% water as a co-solvent. Solubility and dispersibility is determined at ambient conditions of temperature and pressure (25°C at and 101.3 kPa (1 Atm)).

Resins preferred for use in the compositions of the present invention include anionic, nonionic, and amphoteric resins and mixtures thereof. Preferred resins for use herein are selected from : acrylate/ acrylamide copolymer, polyvinyl methyl ether/maleic anhydride copolymer, vinyl acetate/crotonic acid copolymer, octylacrylamide/ acrylate/butylaminoethyl methacrylate copolymer, polyvinylpyrrolidone (PVP) , copolymers of polyvinylpyrrolidone and methylmethacrylate, copolymers of polyvinylpyrrolidone and vinylacetate (VA), polyvinyl alcohol, copolymers of polyvinylalcohol and crotonic acid, copolymers of polyvinylalcohol and maleic anhydride, hydroxypropyl cellulose, hydroxypropyl guar gum, sodium polystyrene sulfonate, polyvinylpyrrolidone/ethylmethacrylate/ methacrylic acid terpolymer, vinyl acetate/crotonic acid/vinyl neodecanoate copolymer, octylacrylamide/acrylate copolymer, monoethyl ester of poly(methylvinylether-maleic acid), aluminium starch octenyl-succinate and mixtures thereof. Particularly preferred resins for use in the compositions of the present invention include acrylate/ acrylamide copolymers available under the trade name Ultra Hold 8 (RTM) (from

BASF Corp.), polyvinylmethylether/maleic anhydride copolymers available under the trade name Gantrez (RTM) (from GAF Corp.), vinyl acetate/crotonic acid copolymers available under the trade name Luviset CA-66 (RTM) (from BASF Corp.), octyl acrylamide/acrylate/butylaminoethyl methacrylate copolymers available under the trade name Amphomer (RTM) (from National Starch), vinylcaprolactam/vinylpyrrolidone/dimethylaminoethyl methacrylate terpolymer available under the trade name Hold EP 1 (RTM) available from GAF, polyvinylpyrrolidone, copolymers of polyvinylpyrrolidone and vinyl acetate available under the trade name Luviskol (RTM), an example being Luviskol VA64 (PVA/VA 60/40), and mixtures thereof. Highly preferred resins in compositions according to the present invention are Ultra Hold 8 (RTM) and Amphomer (RTM) and mixtures thereof. The mass average molecular weights of the desired hair setting polymer resins are generally in the range from about 2,000 to about 2,000,000.

In addition cationic and nonionic resins may be utilised as detailed below. Polycationic hair conditioning polymer resins suitable for use herein are described below. For convenience in describing the polymers hereof, monomeric units present in the polymers may be referred to as the monomers from which they can be derived. The cationic monomers can be derived from polymerizable cationic starting monomers, or from polymerizable nonionic monomers which are modified subsequent to polymerization to be of cationic character.

These cationic unsaturated monomers can be polymerized in cationic form, or as an alternative they can be polymerized in the form of their precursors, which are then modified to be cationic, for example, by a quaternizing agent (eg. ethyl monochloroacetate, dimethyl sulfate, etc.). Preferred cationic monomers include dimethylaminoethyl methacrylate, quaternized dimethylaminoethyl methacrylate, diallyldimethyl ammonium chloride, vinylimidazolium quaternary ammonium monomers and mixtures thereof.

Representative examples of nonionic monomers are acrylic or methacrylic acid esters of C<sub>1</sub>-C<sub>24</sub> alcohols, such as methanol, ethanol, 1-propanol, 2-propanol, 1-butanol, 2-methyl-1-propanol, 1-pentanol, 2-pentanol, 3-

pentanol, 2-methyl-1-butanol, 1-methyl-1-butanol, 3-methyl-1-butanol, 1-methyl-1-pentanol, 2-methyl-1-pentanol, 3-methyl-1-pentanol, t-butanol, cyclohexanol, 2-ethyl-1-butanol, 3-heptanol, benzyl alcohol, 2-octanol, 6-methyl-1-heptanol, 2-ethyl-1-hexanol, 3,5-dimethyl-1-hexanol, 3,5,5-trimethyl-1-hexanol, 1-decanol, 1-dodecanol, 1-hexadecanol, 1-octadecanol, and the like, the alcohols having from about 1-24 preferably from about 4-18, more preferably from about 4-12 carbon atoms; styrene; chlorostyrene; vinyl esters such as vinyl acetate; vinyl chloride; vinylidene chloride; acrylonitrile; alpha-methylstyrene; t-butylstyrene; butadiene; cyclohexadiene; ethylene; propylene; vinyl toluene; alkoxyalkyl (meth)acrylate, such as methoxy ethyl (meth)acrylate and butoxyethyl (meth)acrylate; and mixtures thereof. Other nonionic monomers include acrylate and methacrylate derivatives such as allyl acrylate and methacrylate, cyclohexyl acrylate and methacrylate, oleyl acrylate and methacrylate, benzyl acrylate and methacrylate, tetrahydrofurfuryl acrylate and methacrylate, ethylene glycol di-acrylate and -methacrylate, 1,3-butyleneglycol di-acrylate and -methacrylate, diacetoneacrylamide, isobornyl (meth)acrylate, and the like.

Preferred nonionic monomers include n-butyl methacrylate, isobutyl methacrylate, 2-ethylhexyl methacrylate, methyl methacrylate, t-butylacrylate, t-butylmethacrylate, and mixtures thereof.

Representative polar nonionic monomers include acrylamide, N,N-dimethylacrylamide, methacrylamide, N-t-butyl acrylamide, methacrylonitrile, acrylamide, acrylate alcohols (eg. C<sub>2</sub>-C<sub>6</sub> acrylate alcohols such as hydroxyethyl acrylate, hydroxypropyl acrylate), hydroxyethyl methacrylate, hydroxypropyl methacrylate, vinyl pyrrolidone, vinyl ethers, such as methyl vinyl ether, acyl lactones and vinyl pyridine, allyl alcohols, vinyl alcohols and vinyl caprolactam.

Preferred polycationic polymer resins for use herein include cationic guar gum, cationic polysaccharides, homopolymers of dimethyldiallyl ammonium chloride, copolymers of dimethyldiallyl ammonium chloride and acrylamide, cationic amino-functional homopolymers and copolymers derived from acrylic acid and/or methacrylic acid, especially from alkylaminoalkyl acrylate and methacrylate monomers such as

dimethylaminoethyl acrylate and methacrylate, polyalkylene imines and ethoxy polyalkylene imines, vinylimidazolium/vinylpyrrolidone quaternary ammonium copolymers, and mixtures thereof.

### Neutralising System

The hair styling polymers herein are preferably utilised in at least partially neutralised form in order to aid shampoo removability of the liquid hair cosmetic compositions. In the compositions according to the present invention the neutralisation of a hair fixative polymer (eg silicone grafted tBA/AA copolymer) may be achieved by use of an inorganic base, preferably KOH. However organic base, preferably AMP (amino methyl propanol) and mixtures of inorganic and organic base may also be used to effect the desired level of neutralisation in hair cosmetic products according to the present invention. In total from about 30% to about 95%, preferably from about 55% to about 75%, most preferably from about 60% to about 70% of the acidic monomers of each polymer utilised should be neutralised with base.

Any conventionally used base, organic or inorganic, may be used for neutralisation of acidic polymers providing they are utilised as specified herein. Hydroxides of alkali, alkaline earth and amino alcohols are suitable neutralisers for use in the present liquid hair cosmetic compositions.

Examples of suitable organic neutralising agents which may be included in the hair cosmetic compositions of the present invention include amines, especially amino alcohols such as 2-amino-2-methyl-1,3-propanediol (AMPD), 2-amino-2-ethyl-1,3-propanediol (AEPD), 2-amino-2-methyl-1-propanol (AMP), 2-amino-1-butanol (AB), monethanolamine (MEA), diethanolamine (DEA), triethanolamine (TEA), monoisopropanolamine (MIPA), diisopropanolamine (DIPA), triisopropanolamine (TIPA), dimethyl steramine (DMS) and amino methyl propanol (AMP) and mixtures thereof.

Preferred neutralising agents for use in hair cosmetic compositions of the present invention are potassium and sodium hydroxides.

The amount in grams of base (Z) required to neutralise any given polymer can be deduced from calculations which take into account the acid value of the polymer (A); amount of polymer (W); mol wt of the base (B); mol wt of the acidic moiety (M) and the degree of neutralisation required (N).

$$Z(g) = W \times A/100 \times 1/M \times B \times N\%$$

In the following example the amount of KOH required to neutralise 2.6g of acrylic acid co-polymer (with an acid value of 20) to a level of 60% neutralisation is calculated.

$$Z(g) = 2.6 \times 20/100 \times 1/72 \times 56 \times 0.60$$

$$Z = 0.24 \text{ g}$$

Note, the acid value can be experimentally determined by titrating a specific amount of the polymer with base or theoretically by considering the original acidic content of the co-polymer i.e. a polymer with 20% of acid monomer has an acid value of 20.

The liquid hair cosmetic compositions of the present invention also include a carrier. This can comprise any of those conventionally used in resin hairspray formulations inclusive of solvents, propellants and other optional ingredients of liquid hair cosmetics. The carrier is generally present in the liquid hair cosmetic compositions at from about 60% to about 99.8%, preferably from about 68% to about 98% by weight. More preferably, the carrier is present at from about 70% to about 98% by weight of the total composition.

Organic solvents suitable for use in the carrier of the present compositions include C<sub>1</sub>-C<sub>6</sub> alkanols, carbitol, acetone and mixtures thereof. C<sub>1</sub>-C<sub>6</sub> alkanols preferred for use in the present compositions are



C<sub>2</sub>-C<sub>4</sub> monohydric alcohols such as ethanol, isopropanol and mixtures thereof.

Liquid hair cosmetic compositions according to the present invention contain from 0% to about 15% by weight of water, preferably from 0% to about 10%, more preferably 0% to 5% by weight of water.

### Plasticizer

The performance of the liquid hair cosmetic compositions according to the invention can be improved through the optional incorporation of a nonvolatile plasticizer into the composition. The plasticizer will generally be present in the compositions according to the invention up to a level of 25%, preferably from 1% to 20%, more preferably from 1% to 15%. As used herein, "nonvolatile" in regard to plasticizers means that the plasticizer exhibits essentially no vapour pressure at atmospheric pressure and 25°C. The polymer-liquid vehicle solution should not suffer from substantial plasticizer weight loss while the hair cosmetic carrier is evaporating, since this may excessively reduce plasticization of the polymer during use. The plasticizers for use herein should generally have boiling points of about 250°C or higher.

Plasticizers are well known in the art and are generally described in Kirk-Othmer Encyclopedia of Chemical Technology, second edition, Volume 15, pp. 720-789 (John Wiley & Sons, Inc. New York, 1968) under the topic heading "Plasticizers", and by J. Kern Sears and J. R. Darby in the text The Technology of Plasticizers (John Wiley & Sons, Inc., New York, 1982). See especially in the Appendix of Sears/Darby Table A.9 at pages 983-1063 where a wide variety of plasticizers are disclosed.

Plasticizers suitable for use in compositions of the present invention include both cyclic and acyclic nonvolatile materials. Suitable categories of nonvolatile plasticizers include adipates, phthalates, isophthalates, azelates, stearates, citrates, trimellitates, silicone copolyols, iso C<sub>14</sub> -

C<sub>22</sub> alcohols, methyl alkyl silicones, carbonates, sebacates, isobutyrate, oleates, phosphates, myristates, ricinoleates, pelargonates, valerates, camphor, glycols, amine derivatives, selected short chain alcohols and castor oil.

Particularly preferred plasticizers for use herein include glycol and citrate based plasticizers such as propylene glycol, dipropylene glycol, acetyl tri-n-butyl citrate, tri-n-butyl and acetyl tri-2-ethoxyhexyl citrate (as supplied by Pfizer under the trade name Citroflex RTM) as well as glycerin, amino methyl propanol (AMP), diisobutyladipate (DIBA) and isopropanol.

### Propellant

The present compositions can be formulated as hairsprays in aerosol or non-aerosol forms. If an aerosol hairspray is desired, a propellant must be included in the composition. This agent is responsible for expelling the other materials from the container and forming the hairspray character.

The propellant gas can be any liquefiable gas conventionally used for aerosol containers. Preferably the density of the propellant or mixture thereof is less than 1 so that pure propellant is not emitted from the container. Examples of materials that are suitable for use as propellants are trichlorofluoromethane, dichlorodifluoromethane, dichlorotetrafluoroethane, monochlorodifluoromethane, trichlorotrifluoroethane, dimethylether e.g. Dimel 152A (RTM) supplied by Du Pont, propane, n-butane, isobutane, used singly or admixed and propane butane e.g. CAP 80 (RTM). Dimel 152A (RTM) and propane butane are preferred.

The amount of the propellant gas is governed by normal factors well known in the aerosol art. For hairsprays the level of propellant is generally from about 10% to about 40%, preferably from about 20% to about 30%, of the total composition. If a propellant such as

dimethylether utilizes vapor pressure suppressant (e.g., trichloroethane or dichloromethane) the amount of suppressant is included as part of the propellant.

The hair cosmetic compositions of the present invention can be made using conventional formulation and mixing techniques. Compositions of the present invention can be made by adding the polymers to ethanol and mixing for several hours until dissolved. Plasticizer and neutralising ingredients are then added and the resulting solution is stirred. Any remaining ingredients such as water, ethanol and perfume can then be added.

Methods of making hair cosmetic compositions of the present invention are described more specifically in the examples.

Alternatively, pressurised aerosol dispensers can be used where the propellant is separated from contact with the hairspray composition by use of specialised containers such as a two compartment can of the type sold under the tradename SEPRO from Americal National Can Corp.

Other suitable aerosol dispensers are those characterized by the propellant being compressed air which can be filled into the dispenser by means of a pump or equivalent device prior to use. Such dispensers are described in US-A-4,077,441, March 7th 1978, Olofsson and US-A-4,850,577, July 25th 1989, TerStege. Compressed air aerosol containers suitable for use are also currently marketed by The Procter & Gamble Company under their tradename VIDAL SASSOON AIRSPRAY (RTM) hairsprays.

Conventional non-aerosol pump spray dispensers, i.e., atomizers, can also be used.

#### Other Ingredients

The liquid hair cosmetic compositions of the present invention can also contain a variety of non-essential, optional components such as preservatives, surfactants, block polymers, thickeners and viscosity modifiers, electrolytes, fatty alcohols, pH adjusting agents, perfume oils,

perfume solubilizing agents, sequestering agents, emollients; lubricants and penetrants such as various lanolin components; protein hydrolysates and other protein derivatives; ethylene adducts and polyoxyethylene cholesterol; sunscreens and volatile and non-volatile silicone fluids. Such conventional optional ingredients are well known to a person skilled in the art, e.g. surfactants such as anionics (e.g., sodium alkyl sulphates, nonionics (amine oxides) ; amphoterics (aliphatic secondary or tertiary amine derivatives) zwitterionics (aliphatic quaternary ammonium; phosphonium or sulphonium derivatives) and fluorinated surfactants (e.g. Zonyl FSK) (RTM); thickeners and viscosity modifiers such as diethanolamides of long chain fatty acids; block polymers of ethylene oxide and propylene oxide such as Pluronic (RTM) F88 offered by BASF Wyandotte; fatty alcohols such as cetearyl alcohol; viscosity modifiers such as sodium chloride, sodium sulphate, and ethyl alcohol; electrolyte such as earth and alkaline-earth metal salts; quaternary ammonium ions and cationic amines and halogen ions; pH adjusting agents such as citric acid, succinic acid, sodium hydroxide and triethanolamine; perfume oils such as Florasynth (RTM) perfumes; perfume oil solubilizers such as polyethylene glycol fatty acid esters and sequestering agents such as ethylenediamine tetraacetic acid. Each of these optional materials can be present at a level of from about 0.05% to about 5%, preferably from about 0.1% to about 3% by weight of composition.

The liquid hair cosmetic compositions of the present invention are used in conventional ways to provide the hair styling/holding benefits of the present invention. Such method generally involves spraying an effective amount of the product to dry or damp hair before or after the hair is styled, or both. By "effective amount" is meant an amount sufficient to provide the hair volume and style benefits desired considering the length and texture of the hair.

The invention is illustrated by the following non-limiting examples.

In the examples, all concentrations are on a 100% active basis, unless otherwise stated and the abbreviations have the following designation:

Silicone Co-Polymer - 60% t-butyl acrylate/20% acrylic acid/20% silicone PDMS. Weight average molecular weights (as measured using SEC) of 150,000.

Non-Si Copolymer 1 - Amphomer (RTM)

Non-Si Copolymer 2 - Ultra Hold 8 (RTM)

KOH - Potassium hydroxide solution, containing 45% potassium hydroxide and 55% water and minors.

AMP - 2-Amino-2-methyl-1-propanol.

DRO Water - Double reverse osmosis water

Solvent - Ethanol

Examples I-VI

The following are liquid hair cosmetic compositions in the form of hairspray compositions suitable for pump spray dispensers and which are representative of the present invention:

	I	II	III	IV	V	VI
Si Containing Copolymer	0.5	6.0	4.5	5.0	2.0	3.0
Non-Si Copolymer 1	4.5	0.5	-	1.0	-	2.0
Non-Si Copolymer 2	-	-	0.5	-	3.0	-
% poly KOH neutralised	60	55	60	50	55	60
% poly AMP neutralised	0	5	0	10	0	0
DRO Water	7	0	7	0	0	7
Balance	----- to 100 percent with Ethanol -----					

The balance contains ethanol and any optional ingredients such as plasticizers, perfume and surfactants.

The hairspray formulations are prepared by adding the polymer directly to the ethanol. A magnetic or air driven stirrer is used to mix the ingredients until the polymer is dissolved, typically about 1 to 2 hours. The neutralizing agent is then added and mixed into the premix. Then, the optional ingredients and water, as may be applicable, are mixed into the composition.

The above compositions have excellent clarity and when applied to the hair impart excellent hair feel and good style retention properties.

Examples VII-XII

The following are liquid hair cosmetic compositions in the form of hairspray concentrate compositions suitable for aerosol dispensers and which are representative of the present invention:

	VII	VIII	IX	X	XI	XII
Si Containing Copolymer	8.0	4.0	4.0	4.5	1.0	2.0
Non Si-Copolymer 1	2.0	-	1.0	-	-	2.0
Non Si-Copolymer 2	-	0.5	-	0.5	8.0	-
% poly KOH neutralised	60	55	55	60	60	50
% poly AMP neutralised	0	5	5	10	0	5
DRO Water	0	0	5	5	10	10
Balance	----- to 100 percent with Ethanol -----					

As in examples I to VI the balance can contain ethanol and optional ingredients such as plasticizers, perfumes and surfactants. The compositions are prepared as in Examples I-VI. The concentrates are packaged in conventional aerosol spray cans and are charged with a conventional liquifiable propellant, such as CAP 80 (propane/butane) (RTM) at a propellant:concentrate weight ratio of 23:77.

The above compositions have excellent clarity and long term and stressed temperature stability characteristics and when applied to the hair impart excellent hair feel and good style retention properties.

## WHAT IS CLAIMED IS:

1. A liquid hair cosmetic composition comprising:
  - a) from about 0.1 % by weight to about 10% by weight (acid basis) of a silicone-containing polycarboxylic acid hair styling copolymer having a vinyl polymeric backbone, and having grafted to the backbone a silicone-containing macromer having a weight average molecular weight of from about 1,000 to about 50,000 ;
  - b) from about 0.01 % by weight to about 10% by weight of a non-silicone-containing hair styling resin ; and
  - c) the balance comprising a carrier suitable for application to hair.

2. A liquid hair cosmetic composition according to Claim 1 wherein the silicone-containing macromer has the general formula (I):

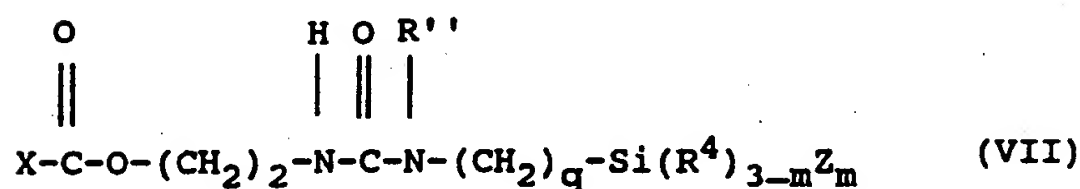
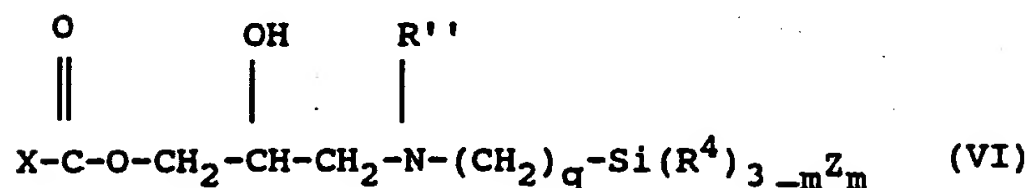
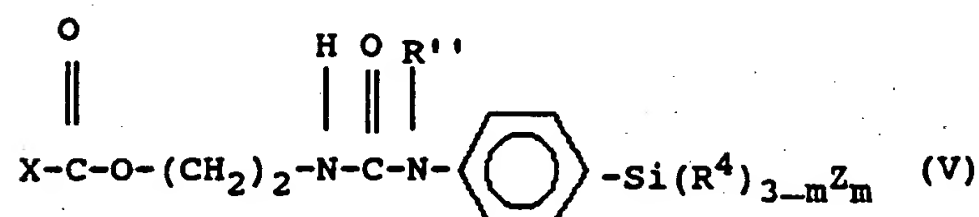
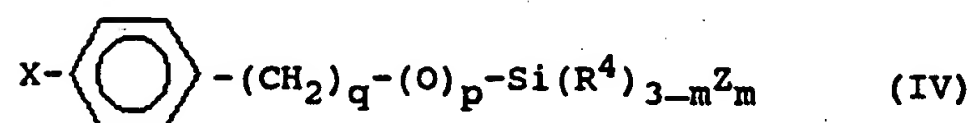
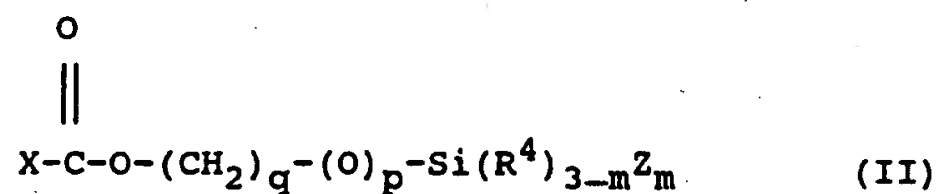


wherein X is a vinyl group; Y is a divalent linking group; R is hydrogen, alkyl, aryl, alkylamino, trialkylsiloxy or alkoxy; Z is a monovalent siloxane polymeric moiety having a number average molecular weight of at least about 500; n is 0 or 1; and m is an integer from 1 to 3.

3. A liquid hair cosmetic composition according to Claim 1 or 2 wherein the silicone-containing copolymer has a weight average molecular weight of from 10,000 to 1,000,000 comprising a hydrophilic carboxylate containing polar monomer (B), optionally , a lipophilic, low polarity, free-radically polymerizable vinyl monomer (A), which is copolymerizable with B, and a silicone-containing macromer (C) having a weight average molecular weight of from 1,000 to 50,000, preferably from 5,000 to 40,000, based



on polydimethylsiloxane and wherein the macromer (C) is selected from one or more monomers having the general formulae (II- VII):



wherein m is 1, 2 or 3; p is 0 or 1; R'' is alkyl or hydrogen; q is an integer from 2 to 6; X is



$R^1$  is hydrogen or  $-\text{COOH}$ ;  $R^2$  is hydrogen, methyl or  $-\text{CH}_2\text{COOH}$ ;  $Z$  is



$R^4$  is alkyl, alkoxy, alkylamino, aryl or hydroxyl; and  $r$  is an integer from 5 to 700; and wherein the silicone-containing copolymer comprises from 0% to 98% monomer A, from 1% to 98% monomer B, and from 0.1% to 50% monomer C.

4. A liquid hair cosmetic composition according to any of Claims 1 to 3 wherein the silicone-containing copolymer comprises from 5% to 92% by weight monomer A, from 7.5% to 80% by weight monomer B, and from 0.1% to 50% monomer C.
5. A liquid hair cosmetic composition according to any of Claims 1 to 4 wherein monomer A is selected from acrylic acid esters of  $\text{C}_1$ - $\text{C}_{18}$  alcohols, methacrylic acid esters of  $\text{C}_1$ - $\text{C}_{18}$  alcohols, styrene, polystyrene macromer, vinyl acetate, vinyl chloride, vinyl propionate, vinylidene chloride, alpha-methylstyrene, t-butylstyrene, butadiene, cyclohexadiene, ethylene propylene, vinyl toluene, and mixtures thereof; and is preferably selected from n-butylmethacrylate, isobutylmethacrylate, 2-ethylhexylmethacrylate, methylmethacrylate, t-butylacrylate, t-butylmethacrylate, and mixtures thereof.
6. A liquid hair cosmetic composition according to any of Claims 1 to 5 wherein monomer B is selected from acrylic acid, methacrylic acid, maleic acid, maleic anhydride, half esters of maleic anhydride, crotonic acid, itaconic acid, and mixtures thereof; and is preferably selected from acrylic acid and methacrylic acid, and mixtures thereof.

7. A liquid hair cosmetic composition according to any of Claims 3 to 6 wherein the silicone-containing macromer has the general formula (II) in which  $p=0$  and  $q=3$ ,  $m$  is 1,  $R^4$  is alkyl,  $R^1$  is hydrogen and  $R^2$  is methyl.
8. A liquid hair cosmetic composition according to any of Claims 1 to 7 wherein the silicone-containing copolymer is selected from:  
  
acrylic acid/n-butylmethacrylate/polydimethylsiloxane (PDMS) macromer - 20,000 mw (10/70/20);  
acrylic acid/isobutyl methacrylate/PDMS macromer - 20,000 mw (20/60/20);  
acrylic acid/isobutyl methacrylate/PDMS macromer - 20,000 mw (10/70/20);  
acrylic acid/methyl methacrylate/PDMS macromer - 20,000 mw (40/40/20);  
acrylic acid/isopropyl methacrylate/PDMS macromer - 20,000 mw (25/65/15);  
acrylic acid/methoxyethyl methacrylate/PDMS macromer 20,000 mw (60/25/15);  
acrylic acid/PDMS macromer - 20,000 mw (80/20);  
and mixtures thereof.
9. A liquid hair cosmetic composition according to any of Claims 1 to 8 wherein the silicone-containing hair styling copolymer has a molecular weight in the range of 90,000 to 300,000.
10. A liquid hair cosmetic composition according to any of Claims 1 to 9 wherein the non-silicone-containing hair styling resin can be an anionic, nonionic, amphoteric or cationic polymeric material, or mixture thereof, preferably an anionic or amphoteric polymeric material.
11. A liquid hair cosmetic composition according to any of Claims 1 to 10 wherein the non-silicone-containing hair styling resin has a molecular weight of from about 40,000 to about 150,000 and which is soluble or dispersible in the hair cosmetic carrier system.

12. A liquid hair cosmetic composition according to any of Claims 1 to 11 wherein the non-silicone containing hair styling resin is selected from octyl acrylamide/acrylate/butylaminoethyl methacrylate copolymers, polyvinylmethylether/maleic anhydride copolymers, polyvinylpyrrolidone (PVP) and PVP/vinyl acetate (VA) copolymers and mixtures thereof.
13. A liquid hair cosmetic composition according to any of Claims 1 to 12 wherein the ratio of silicone-containing hair styling copolymer to non-silicone-containing hair styling resin is from about 1000:1 to about 1:1000, preferably from about 100:1 to about 1:100, more preferably from about 10:1 to about 1:10 and especially from about 5:1 to about 1:5.
14. A liquid hair cosmetic composition according to any of Claims 1 to 13 wherein the level of silicone-containing hair styling copolymer is from about 0.5% to about 8%, preferably from about 1% to about 6% by weight.
15. A liquid hair cosmetic composition according to any of Claims 1 to 14 wherein the level of non-silicone-containing hair styling resin is from about 0.05% to about 8%, preferably from about 0.1% to about 4% by weight
16. A liquid hair cosmetic composition according to any of Claims 1 to 15 wherein the total level of silicone-containing hair styling polymer and non-silicone-containing hair styling resin is from about 0.11% to about 20%, preferably from about 0.5% to about 15%, more preferably from about 1% to about 10% by weight.
17. A liquid hair cosmetic product comprising a hairspray composition and spray dispenser means for containing and spraying the hairspray composition, and wherein the hairspray composition comprises:

- a) from about 0.1 % by weight to about 10% by weight (acid basis) of a silicone-containing polycarboxylic acid hair styling copolymer having a vinyl polymeric backbone, and having grafted to the backbone a silicone-containing macromer having a weight average molecular weight of from about 1,000 to about 50,000 ;
- b) from about 0.01 % by weight to about 10% by weight of a non-silicone-containing hair styling resin ; and
- c) the balance comprising a carrier suitable for application to hair.

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US94/05253

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) :A61K 7/11

US CL :424/71

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 424/71, 70

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US, A, 5,120,531 (WELLS ET AL) 09 June 1992, see columns 3, 13 and 15.	1-3, 17
X	US, A, 5,106,609 (BOLICH, JR ET AL) 21 April 1992, see columns 21-25.	1-3, 17
A	US, A, 4,728,571 (CLEMENS ET AL) 01 March 1988, see column 3.	1-3, 17
A	US, A, 4,693,935 (MAZUREK) 15 September 1987, see columns 4-5.	1-3, 17

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

* "A"	Special categories of cited documents: document defining the general state of the art which is not considered to be part of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"B"	earlier document published on or after the international filing date	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"O"	document referring to an oral disclosure, use, exhibition or other means	
"P"	document published prior to the international filing date but later than the priority date claimed	"&" document member of the same patent family

Date of the actual completion of the international search

01 AUGUST 1994

Date of mailing of the international search report

SEP 27 1994

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# INTERNATIONAL SEARCH REPORT

International application No.

PCT/US94/05253

## Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☒ Claims Nos.: 4-16  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐

The additional search fees were accompanied by the applicant's protest.

☐

No protest accompanied the payment of additional search fees.